Statement by Jim Higgins, United States Representative, on Agenda Item 13, "Solar-Terrestrial Physics," February 25, 2004

Mr. Chairman,

Our planet moves in the tenuous outer atmosphere of a variable star that we know as the Sun. Changes on the Sun directly affect our entire solar system and the world community. The physics of solar variability and its effects have an impact on all nations of the world.

Why do we care? Why is research about the Sun-Earth relationship important? Society increasingly depends on space-based systems. Telemedicine, as we already heard, provides global access to health care, and it relies on reliable satellite communications. Humans now have a permanent presence in Earth orbit and eventually we will continue the voyage beyond Earth to the Moon and Mars. Solar variability can affect space systems and human space flight, astronauts & robotic vehicles on Moon and Mars, disrupt electric power transmission and high-frequency radio communications, interfere with GPS signals and long range radar, damage microelectronics, increase radiation to people in high altitude aircraft, and alter terrestrial climate.

Prudence demands that we fully understand the space environment that humankind navigate, whether near Earth or other planets; that we understand "space weather." In addition, given the massive economic impact of even small changes in climate, we should fully understand both natural and human-generated causes of global climate change. Solar variability is a primary natural driver and may be responsible for as much as 30% of the global warming in the past century.

The scope of the endeavor to understand this system stretches from the core of the Sun to the Earth and every other planet out to the far reaches of the solar system. Why does the Sun vary? What produces the powerful solar flares that rock the solar system? How does the Sun manage to expel billions of tons of material at millions of miles per hour in a coronal mass ejection? Where are dangerous energetic electrons and ions accelerated? How are cosmic rays from the galaxy affected when they enter the solar system? How does Earth's magnetic shield that protects the biosphere respond to the variable radiation and particles? How does our atmosphere react to solar changes on long and short time scales? We have only begun to answer these and other important questions. Investigating these questions requires a greater effort than can be mounted in a single program or by a single nation.

International cooperation has long been a vital element in the scientific investigation of solar variability and its impact on Earth and its space environment. The International Geophysical Year almost 50 years ago showed us a first step along this path. Today, a new international cooperative program in solar-terrestrial physics, the International Living With a Star program (ILWS), has been established to stimulate, strengthen, and coordinate space research to understand the governing processes of the connected Sun-Earth System as an integrated entity. ILWS follows the highly successful International Solar Terrestrial Physics (ISTP) program, which has involved partners from Europe, Japan, Russia, and the United States. ISTP, with its steady flow of discoveries and new knowledge in solar-terrestrial physics, has laid the foundation for the coordinated study of the Sun-Earth system as a connected stellar-planetary system, the system that is humanity's home.

The ILWS program will stimulate and facilitate:

- Study of the Sun-Earth connected system and the effects that influence life and society.
- Collaboration among potential partners in solar-terrestrial space missions.
- Synergistic coordination on international research in solar-terrestrial studies, including all relevant data sources as well as theory and modeling.
- Effective and user-driven access to all data, results and value-added products.

The first step in establishing ILWS was taken in the year 2000 when NASA established the Living With a Star (LWS) program. LWS, along with other NASA Earth Science and Space Science programs, today provides a set of on-going and planned missions that serve a foundation for the International Living With a Star program. The ILWS initiative itself was established in early 2002. The organizational structure for ILWS program consists of a Steering Committee comprised of one member each from the space agencies of Canada, Russia, Japan, Europe and the United States, plus a chair and an executive secretary. The first chairperson is from Europe and the executive secretary is from the United States. This steering committee directs a larger ILWS Working Group comprised of members from twenty five contributing agencies.

Already an international fleet of more than a dozen space missions is constantly acquiring data on the behavior of the Sun-Earth connected system. These missions observe the Sun and its variability, measure conditions in interplanetary space (the heliosphere) through which the solar wind and solar mass ejections flow outward from the Sun and characterize the space environment of Earth.

International Living With a Star (ILWS)

A New Collaborative Space Program in Solar, Heliospheric and Solar Terrestrial Physics

An extreme example of space weather occurred in October and November of 2003, when three immense active regions appeared on the solar surface. The existing fleet of spacecraft, including the U.S. National Oceanic and Atmospheric Administration's Geostationary Operational Environmental Satellites, and a host of ground-based observers around the world observed these huge sunspot groups and their effects. Two of the regions were first observed on the far side of the Sun, two weeks in advance. The magnetic storms from these regions created the fastest solar wind and the most intense x-ray flare ever measured by instruments such NOAA's Solar X-ray Imager. Operations of nearly 60% of NASA spacecraft were negatively impacted by these events occurring on the Sun, radio black-outs occurred, high altitude high latitude aircraft were rerouted, a power outage resulted in Sweden, and new radiation belts were created around the Earth. Auroras were observed much farther from the pole than usual. The impacts would have been worse had precautions not been taken that were based on advance observations. The severity of the storms was not predicted and more needs to be done.

The United State relies on a variety of satellites to monitor space weather. This past October 17th, the first satellite in a new series of satellites under the Defense Meteorological Satellites Program was successfully launched. Named F16, the payload includes new instruments to monitor and image the state of the Earth's upper atmosphere. NOAA operates these satellites for use by weather and space weather forecasters and researchers worldwide.

Several exciting new space missions under development or planned by the international space science community will contribute to ILWS in the coming decade (e.g., Double Star, COSMIC, EPOP, STEREO, Solar-B, AIM, Solar Dynamics Observatory, MMS, GEC, Radiation Belt Storm Probes, Ionosphere-Thermosphere Storm Probes, CORONAS-PHOTON). One highly exploratory mission is Solar Probe – a journey to the Sun that will plunge to within a few million kilometers of the surface to observe how the solar wind is accelerated. When these new missions join the fleet currently in orbit, they will provide even more powerful tools for probing the connected Sun-Earth system.

An extensive global system of ground-based optical, radio, and radar instruments and magnetometers complement the space missions to provide vital information on geomagnetic variability, aurorae, ionospheric variability, and other terrestrial phenomena caused by variations in the Sun's output of electromagnetic radiation, solar wind, and energetic particles. Much of the solar-terrestrial data is accessible to interested students and scientists via the internet. Hence, ILWS research can be carried out at a wide variety of locations around the globe.

Stunning observations, compelling progress, and clear relevance provide a powerful tool for interesting the public and students in science. Numerous websites provide public access to solar-terrestrial observations and information about space weather. Spectacular images and movies of the variable Sun and solar explosions (solar flares and coronal mass ejections) and associated terrestrial phenomena such as aurora have captured the interest of individuals and audiences who have seen them in the media. Understanding and ultimately predicting solar variability and its diverse effects on Earth and human technology involves study of interactions between the most important star and planet in the Universe: the Sun, Our Star, and Earth, the home of humanity. This is the focus of the International Living With a Star program.

Through the International Living With a Star Initiative we hope to galvanize the entire world community to contribute towards key measurements that will fill in the gaps that presently exist in our efforts to understand the Sun-Earth system. Our goal is to continue to expand our knowledge of this system and to educate the people of our world on the weather that arises and exists beyond Earth's immediate environment.

The International Living with a Star program will be the subject of a special presentation at the end of this session. I would also like to encourage subcommittee members to stop by the International Living with a Star exhibit in the entrance hall.

Thank you Mr. Chairman.

Further information can be found on the following web site: http://ilws.gsfc.nasa.gov

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